

# **AEROFast: AEROCapture for Future space tranSPorTation (IPPW-7)**

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## **ABSTRACT**

The aerocapture is a new technology for Solar System exploration that uses a single pass through a planetary atmosphere to decelerate the spacecraft and achieve a targeted orbit. Such manoeuvre saves a significant amount of mass with regard to a more conventional technique of insertion using propelled braking. Interest in developing aerocapture technology stems from the solar system exploration needs: sample return missions, in-situ missions and future manned missions require spacecraft to enter and manoeuvre in a planet's atmosphere in order to meet their mission objectives.

Aerocapture on Mars is for the time being not currently studied by the space agencies. This is the reason why the AEROFast project was proposed in the frame of the European Community Framework n°7 (FP7), as a typical research and development project. Aerocapture technology is at Technology Readiness level (TRL) 2 to 3 in Europe. The objective is to increase the TRL to level 6 through a flight demonstration study performed with the Martian conditions regarding the future Mars Sample Return missions. In order to prepare for such a mission demonstration AEROFast main objective is to reach a TRL 3 to 4 for this technology.

Aerocapture is a system level technology where disciplines such as system analysis and integrated vehicle design, aerodynamics, aerothermal environments, thermal protection systems (TPS), guidance, navigation and control (GN&C), instrumentation need to be integrated and optimized to meet mission specific requirements.

AEROFast project started in January 2009. The aim of this paper is to present the preliminary and achieved results. The frame of the mission has been defined: low cost mission, Soyuz-like Launch performance, optimized entry conditions at 120 km, main characteristics of the spacecraft (three modules vehicle concept).

The three main phases of the aerocapture manoeuvre were assessed:

- Pre-aerocapture phase: Challenge is to master the attitude/position of the S/C before manoeuvre.
- Main aerocapture phase: Goal is to reach an elliptical orbit within a narrow corridor and challenge is to sustain important heat loads.
- Post aerocapture phase (transfer to a parking orbit): to target a quasi circular sun-synchronous orbit at a low altitude.

Emphasis will also be put on the spacecraft complete architecture and lay-out, including the front shield: aerodynamic shape and associated thermal protection system.